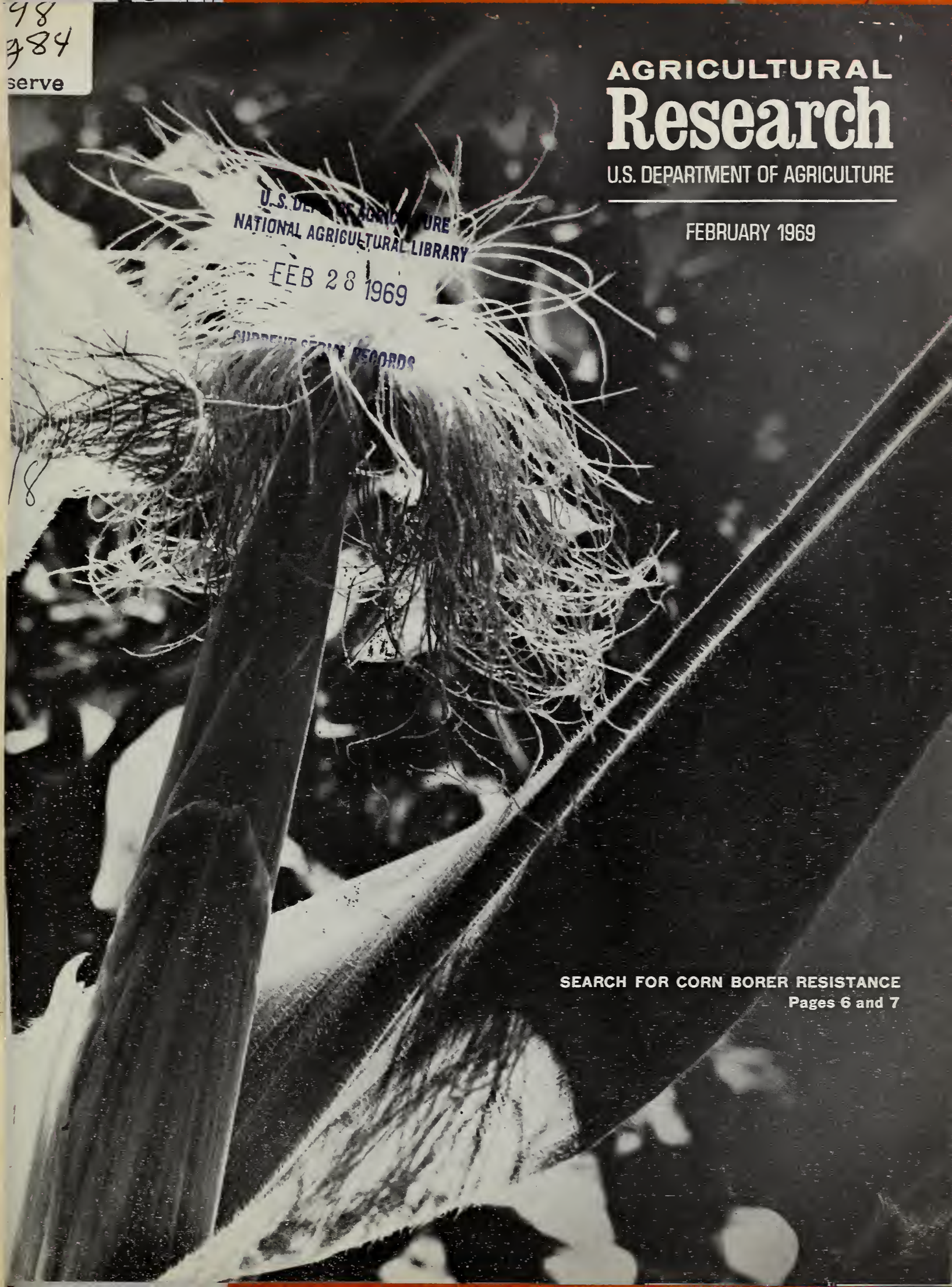
# AGRICULTURAL Research

U.S. DEPARTMENT OF AGRICULTURE

FEBRUARY 1969





SEARCH FOR CORN BORER RESISTANCE
Pages 6 and 7

AGRICULTURAL
# Research

*February 1969/Vol. 17, No. 8*

## Resurgence in the Sugar Bush

The sap will soon flow in the maples, heralding sugaring time—that annual rite begun by the Indian.

When the wild geese flew north, our forebearers boiled down the maple tree's sap for sirup and sugar. These were festive days with a sweet aroma permeating the chill air and youngsters frolicking at sugar-on-snow parties. But behind this idyllic scene lay the realities of back-breaking work and production uncertainties.

Yesteryear's "sugaring off" entailed carrying pails of sap, often over rugged and inaccessible terrain, and the vigil of keeping woodfires going day and night as sap boiled in the sugarhouse. Lacking tests or instruments, sirup making remained a family art. Much of the sirup made was of poor quality.

The sugar bush could return a profit only as long as labor was abundant and cheap. When small farming came under many economic pressures, maple sirup making waned and secmed destined for vanishing Americana along with the buggy and the kerosene lamp.

Research of the last two decades brought a resurgence. Today's producer power drills his trees when convenient in winter, then inserts a sanitizing pellet and plastic spout into the taphole. The pellet greatly increases sap yield by preventing micro-organisms from clogging and prematurely "drying out" the taphole. Each taphole is connected to a network of plastic tubing, often miles long. When the sap runs, it is carried to roadside collecting tanks. The tubing eliminates hand carrying of sap, which accounted for 40 percent of the labor in sirup making.

At the sugarhouse, sap can be safely stored, if need be, under sanitizing ultraviolet lamps. Modern evaporator pans fired by oil or gas and equipped with devices that automatically draw off finished sirup makc sap boiling a modern technology.

Nearly all these changes—and many others—stem from studies conducted or directed by ARS research chemist C. O. Willits. The efforts of Dr. Willits, who retires this month, have reduced labor needs, increased yields, and so enhanced the quality of sirup that half of today's output scores fancy grade. Indecd, Dr. Willits' research brought the maplc industry into the 20th century and helped "sweeten the cup of life."



*Editor: R. P. Kaniuka*
*Managing Editor: E. H. Davis*
*Contributors to this issue:*
*R. C. Bjork, V. R. Bourdette,*
*J. P. Dean, P. U. Fells,*
*D. W. Goodman, M. C. Guilford,*
*M. B. Heppner, D. P. Movitz,*
*N. E. Roberts, D. M. Webb*

AGRICULTURAL RESEARCH is published monthly by the Agricultural Research Service (ARS), United States Department of Agriculture, Washington, D.C. 20250. Printing has been approved by the Bureau of the Budget, June 1967. Yearly subscription rate is $1.50 in the United States and countries of the Postal Union, $2.00 in other countries. Single copies are 15 cents each. Subscription orders should be sent to Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. 

**Clifford M. Hardin, Secretary**
**U.S. Department of Agriculture**

**G. W. Irving, Jr., Administrator**
**Agricultural Research Service**

# Sheepskin Cockle Comes from Keds

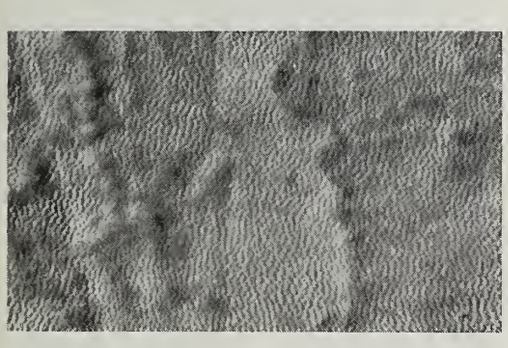
THE WINGLESS PARASITIC FLY known as the sheep tick, or ked, is a more costly pest than has been realized.

Sheep raisers have known that the fly (*Melophagus ovinus*) irritates animals and causes biting and scratching that damages fleeces. Recently, two ARS scientists found that ked bites also make the raised, pimple-like blemishes in sheepskins called cockle.

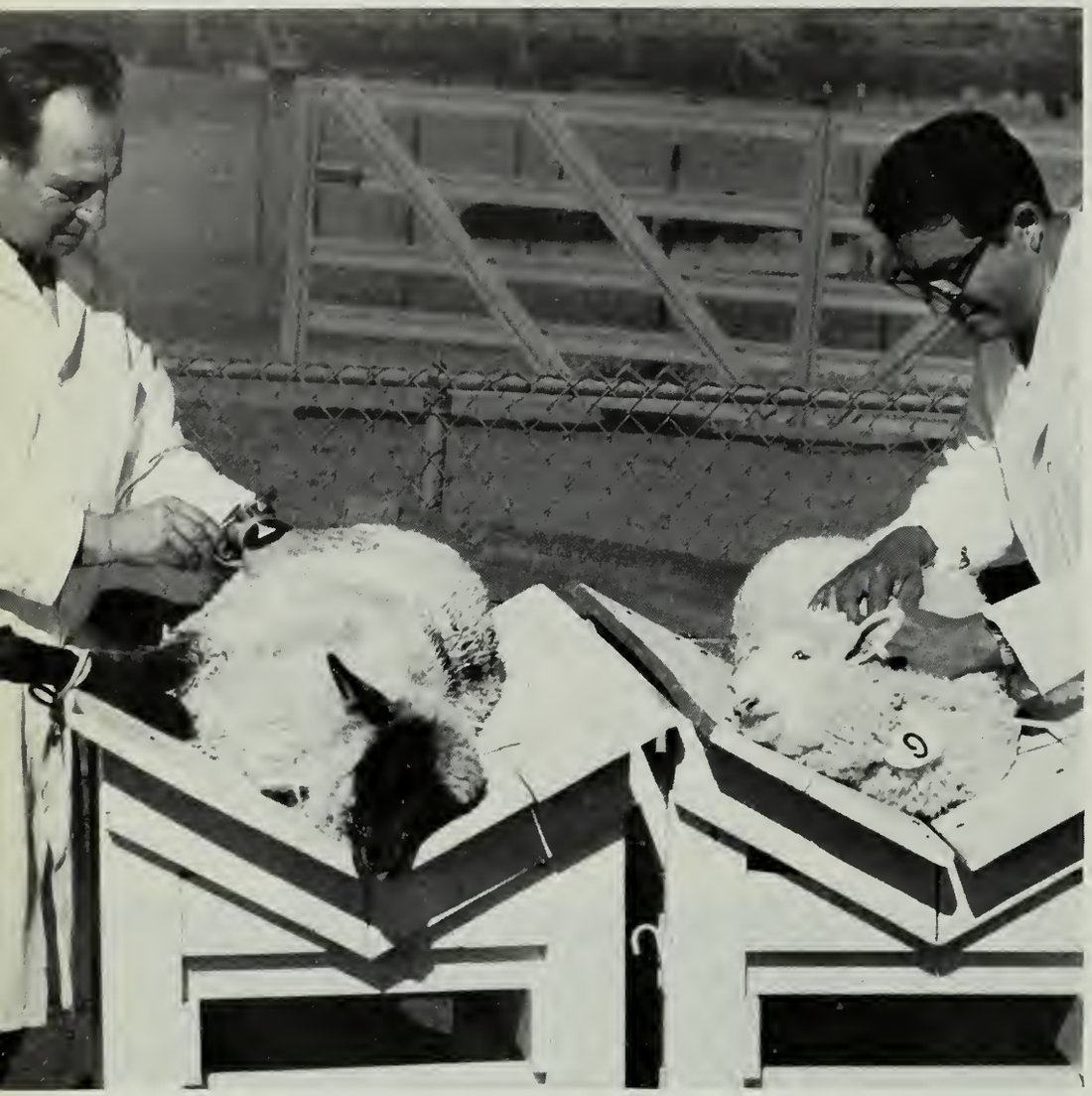
Cockle costs the leather and allied industries millions of dollars a year. The defects are of varying size and elevation and impair both the grain and flesh sides of the skin. They cannot be completely flattened out or covered with dyes and stains.

Now that the cause-effect relationship of keds and cockle is known, treating sheep to eradicate the flies becomes even more important.

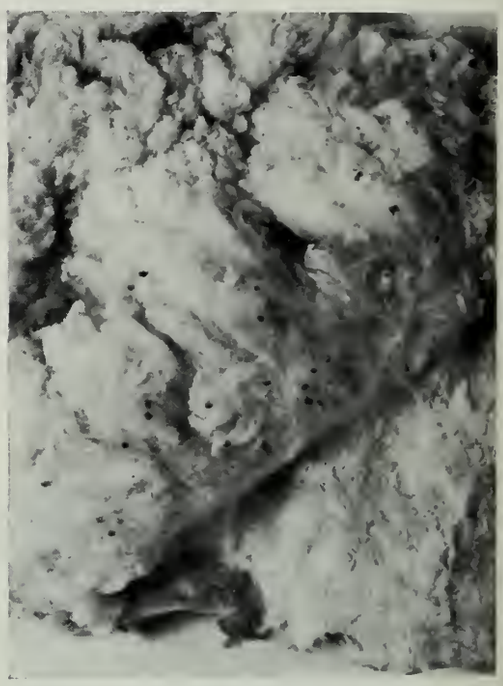
Dipping in vats containing toxaphene, lindane, or rotenone, or dusting with dieldrin are among the most satisfactory of the many approved



***Above:*** *A closeup of sheepskin. Cockle appears as the dark spots of varying size and elevation (PN–1741).* ***Right:*** *Everett holds up sheepskin with cockle defect, which usually appears in a linear pattern, mostly near the neck and shoulders but often on other parts of the body (PN–1740).*



*Left: At the Albuquerque station, Roberts (left) transfers keds from a donor sheep to an experimental animal held by his assistant, S. A. Apodaca (PN–1742). **Below:** The fleece of an infested sheepskin is pulled back, exposing the wingless louse-like keds (PN–7143).*



treatments for ked control. One treatment a year usually provides good control and is most effectively and economically administered shortly after shearing the ewes. If the ewes are shorn after lambing in the spring, special attention should be given to treating the lambs as well as the ewes. In preparing and using insecticides for this purpose, the directions furnished by the manufacturer should be closely followed.

The relationship between keds and cockle was established by two cooperating ARS scientists working nearly 2,000 miles apart: Microscopist A. L. Everett of the Eastern utilization research laboratory in Philadelphia, and I. H. Roberts, veterinarian in charge of the ARS animal parasite station in Albuquerque, N. Mex. Everett, who observed keds in many of the woolskins he examined for cockle, and Roberts, who was throughly familiar with this sheep parasite, inferred that the insect might be causing the skin blemishes.

The two men planned an experiment to test their theory, employing Roberts' facilities for work with live sheep. Roberts worked with a flock of about 150 sheep that had been protected since birth from external parasites. He deliberately infested half of them with keds, keeping the rest in isolation. At regular intervals he selected animals for slaughter and shipped the skins to Everett for analysis.

Extensive cockle in all skins of the infested sheep and virtual absence of the defect in the skins of the animals protected from keds proved conclusively that the insect is responsible.

In later phases of the test, Roberts showed that sheep can spontaneously recover from ked bites. When animals were protected from further bites, either by shearing or by immersing in an insecticide bath, the lesions receded.■

*The mirex-soybean oil mixture is locked into the plastic capsules allowing worker ants to carry them back to the colony for the queen (ST–4446–5).*

# capsule control for Fire Ant

LESS THAN ONE-FOURTEENTH of an ounce of insecticide per acre has given good control of the imported fire ant in small scale tests.

The insecticide, Mirex, was contained in tiny plastic capsules which were as effective as standard bait in the recent ARS-State-industry field trials. And the capsules did the job with less than half the amount of insecticide now being used in the Federal-State fire ant eradication program.

Since 1964, an insecticide bait developed by ARS scientists has been employed in the fight against the fire ant. This bait is a granulated mixture of Mirex, a chlorinated hydrocarbon insecticide; soybean oil, a food that appeals to the ants; and corncob grits, a carrier that makes it possible to distribute the other two ingredients. The bait is spread by aircraft at the rate of 20 ounces per acre.

*Fire ant feeding on unopened okra flower bud (BN–4104).*

Ten percent of the experimental capsules are plastic coating and 90 percent, soybean oil-Mirex. Only 2 percent of the actual bait is insecticide. This combination is effective at the rate of 3 ounces per acre.

Control of fire ants averages about 96 percent with either formulation. One real promise of the tiny capsules is in the reduction of amount needed per acre—a single plane load covers almost seven times as much area as a load of the corncob bait.

Another advantage of the new bait is its longer field life. After weathering outside on a soil surface for 30 days and being exposed to 5 inches of rain in tests, the tiny plastic pills still appealed to the ants and killed them. The normal field life of the corncob bait is less than 48 hours, making retreatment necessary.

The actual amount of insecticide needed for fire ant control is also reduced—from about 4 grams per acre for the corncob bait to less than 2 grams per acre for the capsules.

The baits are effective in such small amounts because they are gathered by worker ants, brought back to the nests and fed to the queen and ant larvae. Even if all the worker ants are not destroyed, the colony will soon die once the queen is dead.

Mirex, in the amounts used, is virtually nonhazardous to humans, pets, wildlife, fish, or bees. In fact, the insecticide is so specific for the fire ant that it will not kill a number of other ant species.

The imported fire ant, a native of South America, is a pest of humans, animals, and crops. Its venom causes boil-like sores and has put many people in the hospital.

The pest entered the United States around 1918 near Mobile, Ala., and now infests more than 100 million acres in Georgia, Alabama, Florida, Louisiana, Mississippi, North Carolina, South Carolina, and Texas.

It eats plant roots, stems, seeds, tender shoots, and some insects. Its large, hard-crusted mounds damage farm machinery and ruin pastures. In the city, it invades lawns, parks, playgrounds and even homes.■

*Left: A susceptible corn plant with the numerous lesions caused by feeding borer larvae (BN–33119).* ***Right:*** *An experimental line showing a highly resistant reaction to first brood borers (BN–33121).*

# DIMBOA: Plant defense against foraging corn borers

Discovery of a built-in defense mechanism that protects corn from the European corn borer could drastically reduce the cost, labor, and time required to breed superior resistance into new lines.

ARS entomologist J. A. Klun, working with Iowa State University scientists at Ankeny, has found that mechanism. He discovered that borers set off a chain reaction with their first nibble, causing enzymes in the leaf tissue to convert glucoside, a plant sugar, to a compound Klun called DIMBOA (2,4-dihydroxy-7-methoxy-1,4-benzoxazin-3-one), which is distasteful to the pests.

Klun, ISU biochemist C. L. Tipton and ARS entomologist T. A. Brindley found that resistant lines of corn contain 10 times more DIMBOA in their leaves and other tissues than nonresistant varieties. Borers' preference for, or rejection of, various lines of corn was closely related to the plants' DIMBOA content. Tests so far have been made with a dozen inbreds and 55 single-cross hybrids of dent corn.

DIMBOA had eluded scientists in earlier studies because it deteriorates rapidly, producing an end product, called MBOA, that is chemically inactive.

MBOA, however, is more easily measured than DIMBOA. Klun and his associates, upon determining that MBOA is directly related to the amount of DIMBOA in corn, devised an accurate, objective technique to determine plant resistance by measuring the amount of MBOA in dried corn tissue. This technique could facilitate the screening of the many lines tested annually for borer resistance.

Klun's test will measure differences in resistance that affect plants at two critical stages in their growth. The initial threat comes from the season's first brood of borers by the time plants reach a height of 33 inches. This brood feeds mainly on the leaves which, in resistant varieties, have high concentrations of DIMBOA.

Later, when corn begins producing pollen, some formerly resistant lines become susceptible. Others continue to show resistance. At this stage of development, the second brood borers prefer the sheath and collar portions of the plants, and some varieties that resist the borers contain greater amounts of DIMBOA in sheath and collar tissue than those that become susceptible. Scientists working on this problem have evidence that other resistance factors may also be operating at this time.

Plant scientists now plan to breed high DIMBOA content into varieties that are susceptible to either first- or second-brood borer attacks. Fortunately, preliminary studies indicate that genetic traits governing high DIMBOA content are dominant over low-content traits.

Another potentially promising use of DIMBOA may be as a spray to protect susceptible lines of corn. In preliminary tests, borers abandoned plants that had been sprayed with DIMBOA solutions. As a natural constituent of corn, DIMBOA would not be expected to produce residue problems, although tests have yet to bear out this premise.

DIMBOA also has other virtues, according to studies by scientists in California, Kansas, and Pennsylvania. DIMBOA is responsible for plant resistance to two diseases—wheat stem rust and corn stalk rot. DIMBOA's end product, MBOA, suppresses molds and bacteria, and another derivative acts as an agent to control convulsions in people. Moreover, DIMBOA protects corn from harmful effects of certain weed killers, enabling safe use of these herbicides in corn fields.■

*Top: Guthrie collects sheets of waxed paper on which caged moths laid their eggs (PN–1744). Center: The sheets, containing several hundred eggs each, are cut into disks with a mechanical punch (PN–1745). Bottom: The disks are then distributed in corn plots to create artificial infestations (PN–1746).*

# STREAMLINING THE TESTS
## for corn borer resistance

ONE OF THE BRIGHTEST prospects for minimizing insect losses in future crops is to breed resistance into new hybrids—a program that, although far from complete, has already produced big gains for farmers.

Ten to 20 years ago, most hybrid corn was highly susceptible to borers and current losses would increase threefold if resistant hybrids, developed by ARS, State, and industry researchers, were not available. Even now, scientists are looking for more specific genetic and chemical keys to corn borer resistance that would allow plant breeders greater precision in developing hybrids with the desired characteristics.

To streamline the search for genetic resistance factors, ARS entomologists W. D. Guthrie, T. A. Brindley, and F. F. Dicke and agronomist L. H. Penny developed controlled levels of artificial infestations and a rapid rating system to measure plant damage.

Working with Iowa Agricultural Experiment Station scientists at Ankeny, the entomologists reared millions of borers in the laboratory and created artificial infestations more severe than most farmers are ever likely to encounter.

About 80 eggs laid by laboratory moths were placed on each test plant. Most borers that hatched on resistant lines of corn died within 5 days.

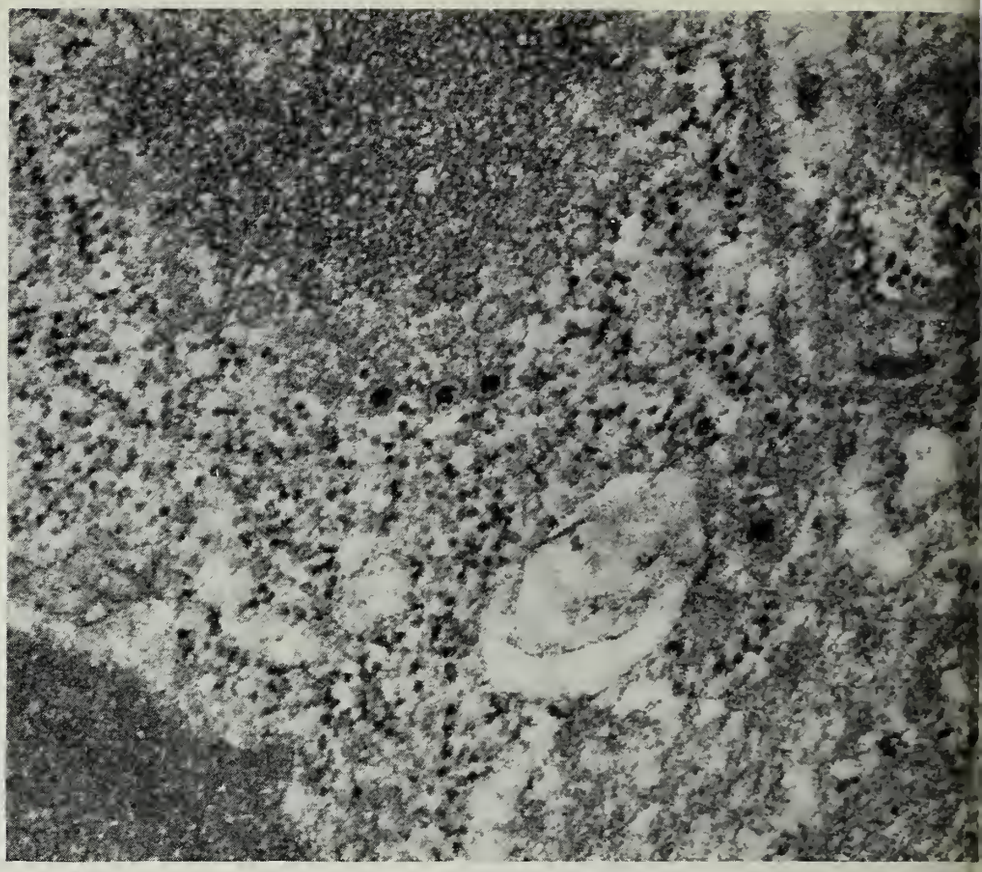
To measure leaf feeding damage, Guthrie and Brindley developed a scale that corresponds closely to genetic resistance or susceptibility. Using this scale, one man can screen up to 40,000 plants in as little as 8 days—a faster and more accurate system than counting the number of borers infesting plants.

Of the thousands of breeding lines screened at Ankeny and at Ames, Iowa, only a few may be developed into commercial hybrids, Guthrie says. These lines will contain the genetic treasure of hundreds of plants tested for borer resistance, high yields, disease resistance, and other desirable agronomic qualities.

Tests so far show that borer resistance is transmitted by dominant genes in some lines. In others, resistance results from accumulation of desirable genes introduced from various resistant lines. Most resistance in hybrids results from concentration of desirable genes in the plant's inbred forebears.

In related tests, scientists have located genes responsible for leaf-feeding resistance on four of the corn plants' ten pair of chromosomes.

Inbred lines with a good degree of first-brood (leaf-feeding) resistance are being used in hybrids. Inbred lines that are resistant to a first-brood infestation, however, are not necessarily resistant to a second-brood (sheath- and collar-feeding) infestation. A good source of germ plasm for resistance to a second-brood borer infestation has been found; breeding techniques for transferring this type of resistance to susceptible inbreds will soon be determined.■



***Left:*** *A Shorthorn heifer with acute symptoms of bluetongue—swollen muzzle and lips, thick saliva, and swollen, protruding tongue (PN–1747).* ***Right:*** *Electronmicrograph of the virus, seen as circles with dark centers, in the salivary gland of a gnat (PN–1748).*

# BLUETONGUE *turns to Cattle*

BLUETONGUE, a serious disease of sheep in the United States and many other countries, is now becoming a real problem for cattle, too.

Herdsmen report that infected cattle have swollen lips, gums and tongues, and saliva hangs from the mouth in long strands. Cattle move stiffly at first but their discomfort seems to pass as they move around.

Although these symptoms have elements common to virus diarrhea, rinderpest, foot-and-mouth disease, and vesicular stomatitis—all serious cattle diseases in some part of the world, a group of scientists at ARS' Denver Animal Disease Laboratory confirmed that the causative virus is bluetongue of the type known from sheep research.

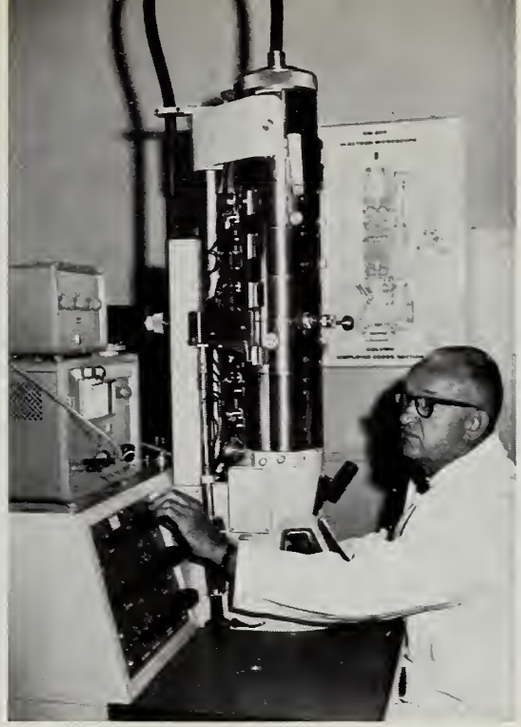
Veterinarian J. G. Bowne, head of the Denver group, says that bluetongue has caused cattle deaths from abortion and secondary infections, but most infected cattle have recovered. Bowne estimates, in fact, that only 2 to 5 percent of the cattle infected with bluetongue virus are detected. At the Denver laboratory, only the mildest symptoms, such as lack of appetite and a slight fever, resulted from experimental infection of cattle with bluetongue virus.

Relative resistance of cattle to bluetongue is a mixed blessing, however, because carrier cattle threaten sheep. Overseas, doors are being closed to U.S. cattle because foreign nations that don't have bluetongue fear it will get started in their sheep.

The transmission of bluetongue between cattle and sheep is true cause for concern because of a disease-carrying gnat that bites both classes of livestock. Photomicrographs taken at Denver showed that the gnat carries bluetongue virus in its salivary glands, apparently in quantities great enough that one bite can infect an animal.

To study cross contamination in the laboratory, ARS researchers allowed gnats to bite cattle and sheep infected with bluetongue virus by inoculation. Gnats were recovered, and after 2 weeks, during which the virus had a chance to multiply inside the gnats, the insects were turned loose again on uninfected sheep and cattle.

All cattle exposed to the virus-laden gnats developed high levels of virus and corresponding antibodies in the blood. Although symptomatic reaction was mild, the cattle maintained



***Below:*** *Test slide is prepared for the precipitin test to detect antibodies in the blood serums of recovered animals (PN–1749).* ***Top right:*** *Bowne adjusts electron microscope to photograph virus. This work was the first time an animal virus had been photographed inside the salivary glands of a transmitting insect (PN–1750).* ***Center right:*** *Veterinarian exposes gnats to infected sheep for transmission trials (PN–1751).* ***Bottom right:*** *Technician inoculates chicken embryo as part of blood tests for the virus. The method holds great promise for practical confirmation of field cases (PN–1752).*

these high levels of virus in the blood up to 1 year after infection. Most sheep on trial developed fullblown symptoms, whether they were infected by syringe or by gnats that carried virus from sheep or cattle. Apparently, cattle can be a true reservoir of bluetongue virus.

Bluetongue in cattle has been reported principally in the West. Recently, cases have also been reported in such widely separated States as Minnesota, Indiana, and Florida.

Vaccines to prevent bluetongue in cattle are not available, and antibiotics to treat it have not been found. All ranchers can do, Bowne says, is to spray insect repellent on cattle, and to keep cattle away from low-lying ground, especially at dusk and throughout the night.■

# Ordeal by Fire Blight

## Infected orchard yields clues to pear resistance

A "FIRE" swept through the ARS pear orchard at Beltsville, Md., last summer as scientists stood idly by—but for good reason, they quickly added.

This was no ordinary fire, but rather fire blight—a centuries-old disease of apple, pear, quince, and other rosaceous hosts. Although flameless and smokeless, fire blight inflicts damage similar to that of a flaming fire—a trail of scorched leaves and trees.

The fire blight epidemic that spontaneously raged through the Beltsville orchard will hopefully speed research toward a possible cure or at least ways to prevent or control this economically serious bacterial disease.

Since the first recorded observation of fire blight in the Hudson River Valley of New York in 1780, it has gradually spread across the entire country, reaching California in the early 1900's. The disease is so severe on pears in the warm, humid States of the Midwest, South, and Atlantic Seaboard that only the most resistant varieties can be grown. In the cooler, drier areas of the Rocky Mountains and West Coast, susceptible varieties can be grown when critical attention is given to control measures.

The infested orchard at Beltsville, which includes about 600 pear varieties from all over the world, affords a natural workshop for the study of resistant and susceptible varieties.

Many trees were killed outright by the blight. A few remained intact, bearing fruit and showing little if any evidence of the disease.

Of the trees that appear resistant to fire blight, many are Asian varieties. The fruit of these trees, however, is usually small, bitter, and full of grit cells. Varieties from European sources, which produce more attractive and better quality fruit, are more susceptible.

Developing high-quality, resistant varieties is the objective of ARS researchers T. van der Zwet, H. L. Keil, H. J. Brooks, and experiment station scientists across the country.

Van der Zwet is concentrating on the infection patterns of the disease while Keil is studying chemical control methods. Brooks is the principal investigator in efforts to breed for resistance. Climatic conditions, considered a major factor influencing the development of fire blight, are likewise being given much attention. Fire blight, for example, often develops in trees injured by hail storms.■

***Left:*** *Van der Zwet stands beside a 4-year-old Brederode pear tree, a Dutch variety, that is blighted to the ground (PN–1753).* ***Right:*** *Tree juices ooze from blighted tree. The release of juice is one of the effects of fire blight (PN–1754).*

## Preharvest Treatments Bring

# Early Orange to Ripe Tangerines

PREHARVEST TREATMENTS to synchronize tangerine ripeness with color break—the degreening process that brings on the bright orange color—are producing encouraging results.

Under normal growing conditions, the early-maturing tangerines usually become ripe and attain minimum eating quality requirements in late September or early October, long before the inception of color break or the internal release of the fruit's ethylene. It is the ethylene that stimulates degreening and influences the orange-red pigment, primarily by removing the green chlorophyll background.

ARS researchers W. C. Cooper, G. K. Rasmussen, and J. J. Smoot have, under experimental conditions, successfully moved up the normal date of color break by applying preharvest sprays of ascorbic acid (vitamin C) and other ethylene-releasing agents.

The common practice in degreening tangerines is to apply ethylene as a postharvest treatment, but this method has generally resulted in a high incidence of decay.

Tests involving preharvest sprays of several ethylene-releasing agents were made on orchard trees of Robinson, Temple, and Murcott tangerines at the U.S. Horticultural Research Station, Orlando, Fla.

With the Robinson tangerine, which colors relatively early, the ascorbic acid (AA) spray applied to the whole tree in the field was almost as effective in degreening as postharvest applications of ethylene. The fruit degreened on the tree by AA treatment had a longer shelf life than fruit degreened in ethylene rooms as a postharvest treatment.

Ethrel, another ethylene-releasing agent, was equally as effective as AA, but severe defoliation resulted when concentrations higher than 100 parts per million were used. Sprays of both AA and ethrel were applied at the beginning of color break.

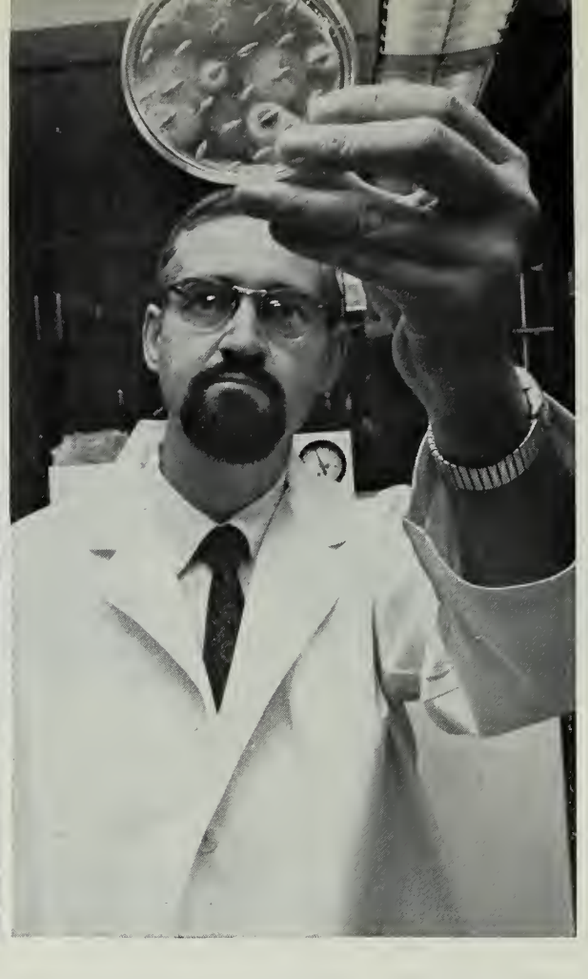
Temple tangerines still have a green peel color when the ripeness factors—sugar to acid ratio and flavor—have reached commercial maturity. When Temple tangerines were treated after color break, AA and abscisic acid (ABA) accelerated coloring of the fruit. ABA also increased aging (stem-rind breakdown). Both AA and ABA appeared to stimulate color beyond that expected from natural degreening.

Murcott trees were sprayed after the development of their normal orange color—a color less intense than Temple or Robinson. The spray treatments significantly enhanced the Murcott color.

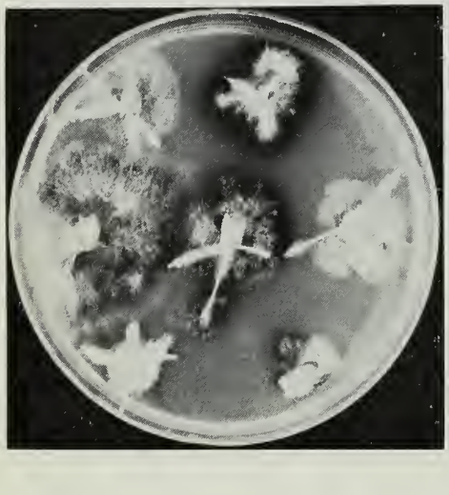
Although outstanding advances are being made with these ethylene-releasing agents, further investigations are necessary to fully determine their usefulness.

Also of interest to the ARS researchers is the relationship of cool temperatures to ethylene production in fruits. The association of cool weather in the fall to the natural degreening of citrus, particularly Navel oranges in California, suggests the probability that chilling at temperatures no lower than 40° F. somehow alters the metabolism of the fruit and causes ethylene production. Tests on two small-fruiting calamondin trees were conducted on the basis of this theory. The fruits receiving the cold and AA treatment degreened; the fruit on the untreated control tree did not.

Whether degreening is promoted by AA treatment or by exposure to cool temperatures, there is the probability that a wound mechanism (if not physical injury, then a metabolic lesion) triggers the rise in ethylene synthesis.■



***Below:*** *Septorium fungi, wheat disease agents, grow out of wheat seeds. Growth of other fungi was restricted for a more accurate count (PN–1755).* ***Right:*** *Woodstock examines fungal growth on barley seeds (ST–4438–1).*



## P.L. 480 researchers find

# Better Tests for Seed-Borne Fungi

DUTCH SCIENTISTS have combined and refined known techniques to develop new, accurate, and standardized methods of testing for seed-borne pathogenic fungi.

Although a newly sown crop can be severely damaged by disease-causing fungi, seeds sold in the United States are not, at present, routinely tested for such fungi. Several test methods are available, but they give such variable results that accurate, routine methods are needed, say ARS botanist O. L. Justice, Hyattsville, Md., and M. M. Kulik, ARS seed pathologist at Beltsville, Md.

Test results can vary depending on the seed condition and on the presence of seed-borne bacteria, pathogenic fungi, and saprophytic (non-parasitic) fungi. Possible seed resistance to fungal infection and competition between bacteria and fungi for seed nutrients, for example, could cause fungal dormancy. Dormant fungi may go undetected and later, if the seed should weaken, begin to feed and grow. In addition, fast-growing surface saprophytic fungi on seeds may obscure slower-growing pathogenic fungi in tests.

To solve these problems, Dutch scientists J. de Tempe and T. Limonard tested seeds of many plants including legumes, vegetables, and cereals in studies to correct variability and to select appropriate techniques for detecting specific disease organisms in seeds of specific host crops.

The researchers eliminated host resistance by killing seeds through deep-freezing, and they reduced bacterial competition with such antibiotics as oxytetracycline. To assure accurate fungal count and identification, the scientists used an established method of near ultraviolet light treatment to induce spore formation.

In comparing the merits of two common tests, blotter and agar, they determined that fungi causing blight, foot rot, leaf spot, and pod spot in peas, collectotrichum or anthracnose in beans, and phoma leaf spot and root rot in beets were more accurately detected with the agar method after a chlorine pretreatment. In most cases, however, they found that chlorine pretreatment will destroy many surface-borne saprophytic fungi at the sacrifice of some pathogenic fungi.

For detecting fusaria in most seed species, the Dutch scientists determined that a peptone pentachloronitrobenzene agar was highly selective and eliminated nearly all competition from other fungal species. For fusaria in cereal seeds, however, the blotter method was preferable.

This 5-year project in the Netherlands was conducted at the Government Seed Testing Station, Wageningen, under a Public Law 480 grant awarded by ARS. Sponsoring scientists in ARS were Justice and plant physiologist, L. W. Woodstock, Beltsville, Md.■

## Light technique adapted to

# sorting green tomatoes

While it won't stop everyone from squeezing the fruit, a new tomato-sorting technique being developed by ARS scientists would go a long way toward providing a more uniform, better-quality product for the consumer.

Maturity is the best indicator of the potential market quality of green tomatoes. Yet green tomatoes—be they valuable mature-green or unacceptable immature fruit—look alike. Thus, present commercial sorting techniques, which are usually based on size or external color of the product, are unsatisfactory for sorting green tomatoes.

To improve the determination of tomato maturity, ARS scientists J. T. Worthington and J. N. Yeatman, Beltsville, Md., are adapting the light transmittance sorting technique developed by ARS more than 10 years ago. The technique is based on measuring the amount of light of a particular wavelength transmitted by a Multiple Wavelength Difference Meter through an intact product. According to the readings, researchers can tell the internal characteristics of the product.

Many types of products have been sorted with this technique, but other scientists have based their readings on light transmitted through a product by a single pair of wavelengths. After 18 months of tests involving more than 20,000 tomatoes, however, Worthington found that readings based on two wavelength pairs rather than one pair give a more accurate definition of tomato maturity.

The difference meter does not determine maturity directly; it does measure internal pigmentation, which is closely related to maturity of green tomatoes.

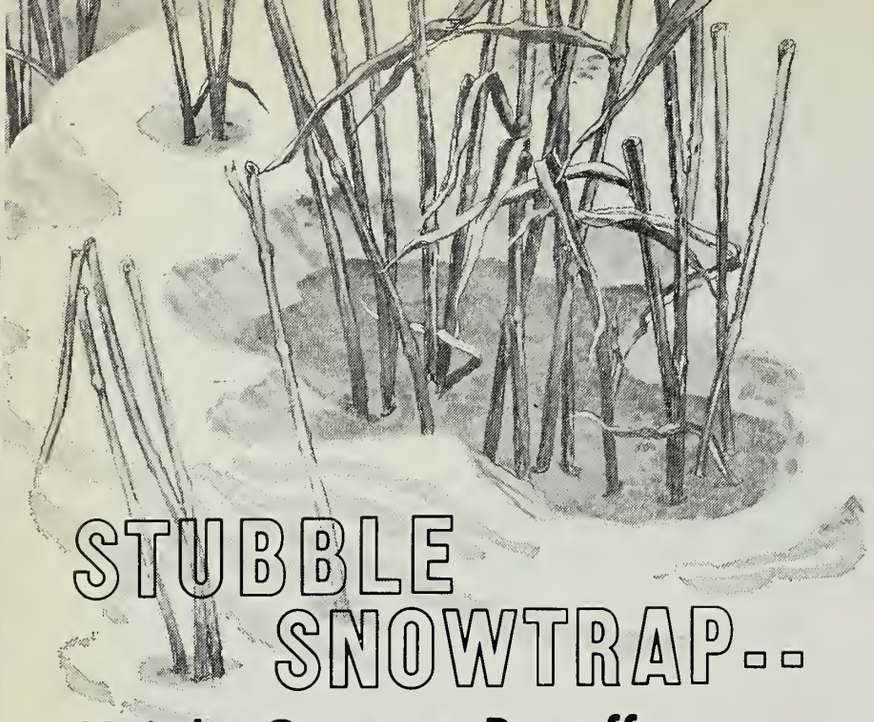
Tests show that the technique is about 85 percent accurate in telling mature-green from immature tomatoes and in separating the former into categories according to how long they will take to ripen. Experienced human judges did little better than a random sorting. The researchers are confident that, with further refinement, the technique can be made even more accurate and they predict that it could one day be incorporated into a commercial sorting system.

The scientists point out that mechanization is currently taking over all phases of tomato handling. A high-speed, high-capacity sorter will be an essential part of a totally mechanized system.

For repackers and shippers, accurate sorting for maturity will eliminate expensive and damaging multiple sorting, cut down guesswork in buying, selling, and storing, extend feasible shipping distances, and help even out fluctuations in market supply.

Produce inspectors have long needed an instrument that could nondestructively separate immature from mature-green tomatoes and predict the ripening rate in the mature fruit. And for the researchers, maturity sorting can eliminate the effects of varied ripeness on experimental results.■

*Worthington measures tomato maturity with meter, which permits sorting without damaging the sample. Agricultural engineer K. H. Norris examines sliced sample (ST–3365–6).*



# STUBBLE SNOWTRAP--

## *Height Governs Runoff*

CONTROLLING the height of standing stubble can serve as a management practice to trap snow, hold snowmelt in place, or partially control snowmelt runoff in the Northern Great Plains.

Snow makes up about 20 percent of the yearly precipitation in that semiarid region and contains 2 to 3½ inches of water. Spring wheat requires from 8 to 10 inches of water in the soil before any grain is produced, and each inch of water in addition to this base quantity increases wheat yields by 3 or more bushels per acre. In some cases, adding a half inch of water could spell the difference between a good crop and a poor one.

ARS scientists in a 6-year study at Mandan, N. Dak., showed that although taller stubble traps and holds more snow, it also makes the snowpack melt faster.

The snowmelt began first on plots with tall stubble (20 inches), next on shorter stubble (10 inches), and last on plots with no standing stubble. The duration of snowmelt decreased with increasing stubble heights.

Differences in snowmelt for the various stubble heights are partly explained by the fact that the standing straws (a) conduct heat into the snowpack; (b) intercept and absorb solar energy; (c) reflect energy onto the snow surface; and (d) provide an effective heat trap.

The ARS scientists know from previous research that the soil moisture level at freezing in the fall affects depth of frost as well as the amount of snowpack runoff in the spring. They also know that grain stubble left standing after harvest effectively traps snow and that snow insulates soil against changes in soil temperature.

However, soil water level in the fall before freezing has more influence on quantity of runoff than does stubble height, for the same depth of snowpack. If a field goes into the winter in a dry condition, for example, runoff is decreased.

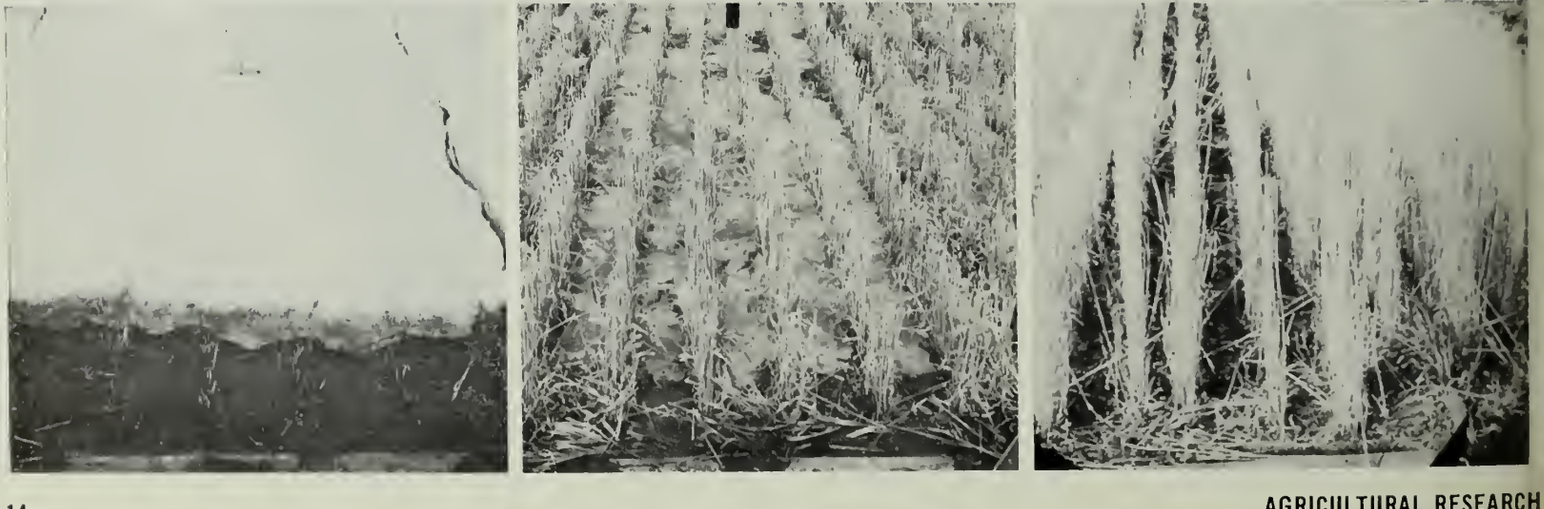
How to incorporate these findings into a snowmelt management system is being researched by ARS soil scientists W. O. Willis, and H. J. Haas at Mandan, and C. W. Carlson at Beltsville, Md.

Studies are underway to measure the effect on snowpack runoff of stubble-mulched strips on the contour in standing stubble. Stubble-mulch tillage is done by subsurface implements that loosen the soil and leave stubble and stalks on the soil surface.

The standing stubble will trap more snow, and the snow in the stubble will melt faster than the snow over the mulched strips. Unmelted snow on the strips should deter surface runoff or snowmelt.

Another way of using tall, standing stubble is on slopes where both faster snowmelt and more runoff are desired to increase water yield into a catchment basin.

*Comparison studies of varying stubble heights show that the higher the stubble, the faster the snowmelt (PN–1756, PN–1757, PN–1758).*



# AGRISEARCH NOTES

## Line-Drying Dripless DP Cottons

A new chemical finishing process for durable press cotton garments may take the "drip" out of line-drying.

The "mild-cure process," as it is called, imparts to cotton fabric the capacity to dry smoothly when hung on a line while damp, after the spin-dry cycle on the washing machine, instead of dripping wet after the rinse cycle. The process gets its name from the relatively low heating, or curing, temperatures employed.

Treatment involves first wetting the fabric with a chemical solution, then heating the wet fabric to 212° F. for 2 minutes to cause a reaction between the chemicals and the cotton. Curing temperatures in conventional processes may range up to 325° F. In the last step, the treated fabric is washed and dried. Lower temperatures can be used, but the reaction time is increased proportionately. The low temperature reaction improves what the chemists call "wet wrinkle recovery."

The process has been carried out only in batch-sized steps on laboratory and semi-pilot plant scale, but the chemists believe it can be carried out on a continuous basis.

Along with the ability to line dry smoothly from a damp-dry state, the treated fabric has all the good properties of cotton treated by conventional processes.

Durable creases have been put into fabric finished by the process, but only on a very limited scale. Further research is needed to determine the best combination of processing conditions on a variety of fabrics before the process is ready for commercial application.

Chemists R. M. Reinhardt, N. A. Cashen, and J. D. Reid developed the mild-cure process at the ARS Southern utilization research laboratory, New Orleans, La.

## New Disease Hits Orchards

A new disease, stem pitting, is threatening stone fruit orchards in several Mid-Atlantic States.

The disorder was observed on 1- to 20-year-old peach and nectarine trees in several commercial orchards during an extensive field survey in 1967. Incidence of stem pitting in the surveyed orchards varied from a few to 80 percent of the trees.

Leaves of diseased trees curl upward lengthwise, droop, and may be chlorotic. These trees, in general, produce off-type fruits that ripen prematurely and fail to size properly. The trunk is markedly enlarged at and below the ground level.

Pitting appears first below the ground and then gradually progresses toward the roots and slightly into the above-ground portion of the trunk.

Trees affected early in life tend to break off easily, at or below ground level. This tendency is related directly to a high proportion of soft, disorganized woody tissue. In no case has

*Chemist R. M. Reinhardt compares cotton fabric processed with the "mild cure" and hung wet on the line with untreated fabric (PN–1759).*

an affected tree shown normal growth rings after development of diseased rings.

Follow-up surveys in 1968 showed additional affected trees, usually adjacent to trees previously affected. Stem pitting also was observed for the first time in sour cherries, European plum (prune), Japanese plum, duke cherry, St. Lucie cherry and Chinese wild peach.

ARS researchers S. M. Mircetich and H. W. Fogle, Beltsville, Md., have studies underway to determine the cause of the disease, rate and mode of spread, and varietal susceptibility. In addition, indicator plants for rapid diagnosis of stem pitting are being sought, as well as resistant varieties and rootstock.

## Fumigating Crated Cereal Products

It's no secret that ARS has been doing undercover work.

A method for safely, effectively, and economically fumigating bagged cereal products in plywood overpacks—crates recently adopted for shipping some military commodities—has been developed by ARS scientists in Savannah, Ga., in cooperation with the Armed Forces Pest Control Board. The crates measure 4 feet by 4 feet by 4½ feet.

The fumigation method—placing aluminum phosphide pellets under the overpacks and covering the stacked overpacks with plastic sheets—was developed for the Armed Forces to prevent insect infestation of flour shipped to Vietnam in the overpacks.

Even with repeated fumigations, phosphine gas given off by the pellets aerates out of the overpacks and leaves no harmful residues. Placing the pellets under the plastic-covered crates simplifies the fumigant application and gives further assurance of safety in handling without reducing the fumigant's killing power. The fumigant has no effect on the flavor or odor of the food.

Phosphine is well suited to the job. It can spread out under the plastic, penetrate the overpack, and diffuse all the way into the center of the crate. At the proper dosage and exposure time, it will kill all insects in the overpacks.

Aluminum phosphide, unlike fumigants that must be kept in heavy metal cylinders, is easy to handle and economical to ship. The fumigation method itself requires no costly labor or equipment. USDA has registered aluminum phosphide and the Armed Forces approved it as a fumigant for use in military supply channels.

## Measuring Cold Tolerance

Two electrolytic processes—electrical resistance and conductivity—have been successfully employed to evaluate cold tolerance of citrus trees.

ARS plant physiologist D. O. Ketchie, working at the U.S. Date and Citrus Station, Indio, Calif., evaluated these processes on hardened and tender citrus plants of the same variety as well as on varieties with different cold tolerances.

To obtain hardened test plants, Ketchie placed half of his plants outside for a 6-week period at day temperatures of 19° C. and night temperatures of about 2° C. The other plants were kept tender in the greenhouse.

Ease-of-bark peeling served to measure dormancy; the amount of defoliation and dead wood 30 days after freezing were used to measure freezing injury.

The methods for measuring cold tolerance electrically are based upon indirect measurement of cell membrane permeability: the hardier the plant, the higher the electrical resistance of tissues in intact plants and the lower the electrical conductivity of water extracted from detached plant segments.

Electrical resistance of hardened plants was found to be approximately three times that of tender plants of the same variety. The amount of electrical conductivity increased with susceptibility to freezing injury.

In earlier work, both electrolytic processes served in evaluating cold tolerance of deciduous fruit trees.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.




U.S. GOVERNMENT PRINTING OFFICE: 1969